WHAT IS CLAIMED IS:

1. A method for fabricating a semiconductor device, comprising the steps of:

forming an oxide film, using a solution including an oxidizer, on a surface of a silicon layer provided at least in part of a semiconductor substrate; and

making the oxide film into an oxynitride film by exposing the oxide film to a plasma having an electron energy of 5 eV or less and containing nitrogen.

2. The method for fabricating a semiconductor device of claim 1, further comprising, before the step of forming an oxide film, the step of forming an isolation region using STI process.

3. A method for fabricating a semiconductor device, comprising the steps of:

removing part of a first oxide film formed on a surface of a semiconductor substrate;

forming a second oxide film, using a solution including an oxidizer, in part of the semiconductor substrate from which the first oxide film has been removed; and

making each of the first and second oxide films into an oxynitride film by exposing the first and second oxide films to a plasma having an electron energy of 5 eV and containing nitrogen.

4. The method for fabricating a semiconductor device of claim 3, further comprising: after the step of forming a second oxide film,

the step of removing part of the second or first oxide film; and

the step of forming a third oxide film, using a solution including an oxidizer, in part of the semiconductor substrate from which the first or second oxide film has been

removed,

wherein in the step of making each of the first and second oxide films into an oxynitride film, the third oxide film is also made into an oxynitride film.

5. The method for fabricating a semiconductor device of claim 3, wherein the thickness of the second oxide film is smaller than that of the first oxide film.

6. The method for fabricating a semiconductor device of claim 3, wherein the first oxide film is formed by thermal oxidation or plasma oxidation.

7. The method for fabricating a semiconductor device of claim 3, wherein the first oxide film is formed using a perchloric acid solution.

8. The method for fabricating a semiconductor device of claim 1, wherein the ion density of the plasma is not less than 5×10^{9} cm^{-3} and not more than 1×10^{12} cm^{-3}.

9. The method for fabricating a semiconductor device of claim 3, wherein the ion density of the plasma is not less than 5×10^{9} cm^{-3} and not more than 1×10^{12} cm^{-3}.

10. The method for fabricating a semiconductor device of claim 1, wherein the temperature of the plasma is not less than 0 C° and not more than 500 C°.

11. The method for fabricating a semiconductor device of claim 3, wherein the temperature of the plasma is not less than 0 C° and not more than 500 C°.

12. The method for fabricating a semiconductor device of claim 1, wherein the plasma is selected one from the group consisting of an inductively coupled plasma, a magnetron plasma, a helicon wave plasma and a surface wave plasma.

13. The method for fabricating a semiconductor device of claim 3, wherein the plasma is selected one from the group consisting of an inductively coupled plasma, a magnetron plasma, a helicon wave plasma and a surface wave plasma.

14. The method for fabricating a semiconductor device of claim 1, wherein the oxidizer is nitric acid.

15. The method for fabricating a semiconductor device of claim 3, wherein the oxidizer is nitric acid.

16. The method for fabricating a semiconductor device of claim 1, further comprising, after the step of making the oxide film into an oxynitride film, the step of performing thermal treatment to the semiconductor substrate in an atmosphere containing oxygen.

17. The method for fabricating a semiconductor device of claim 3, further comprising, after the step of making each of the first and second oxide films into an oxynitride film, the step of performing thermal treatment to the semiconductor substrate in an atmosphere containing oxygen.

18. The method for fabricating a semiconductor device of claim 16, wherein in the

step of performing thermal treatment, thermal treatment is performed at a process temperature of not less than 800 C° and not more than 1100 C° for a process time of not less than 10 seconds and not more than 120 seconds.

19. The method for fabricating a semiconductor device of claim 17, wherein in the step of performing thermal treatment, a process temperature is not less than 800 C° and not more than 1100 C° and a process time is not less than 10 seconds and not more than 120 seconds.

20. A semiconductor device comprising:

a semiconductor substrate;

a gate insulating film formed on the semiconductor substrate; and

a gate electrode formed on the gate insulating film,

wherein the gate insulating film contains silicon dioxide as a main component and nitrogen and has a physical thickness of not less than 0.3 nm and not more than 3 nm,

wherein the concentration of the nitrogen contained in the gate insulating film is maximum at a distance of 1 nm or less in the depth direction from a surface of the gate insulating film on which the gate electrode is formed,

wherein the maximum concentration of the nitrogen is not less than 5 atomic % and not more than 100 atomic %, and

wherein the nitrogen concentration at the interface between the semiconductor substrate and the gate insulating film is 1.5 atomic % or less.

21. A semiconductor device comprising:

a semiconductor substrate;

a gate insulating film formed on the semiconductor substrate; and

a gate electrode formed on the gate insulating film,

wherein the electrical thickness of the gate insulating film measured by a capacitance-voltage measurement is 0.3 nm or more,

where the electrical thickness of the gate insulating film is not less than 0% and not more than 90% of the electrical thickness of a silicon dioxide film of which the physical thickness is the same as the physical thickness of the gate insulating film, and

wherein a leakage current flowing in the gate insulating film when a driving voltage of not less than 0.5 V and not more than 2 V is applied is not less than 1/10000 and not more than 1/3 of a leakage current flowing in the silicon dioxide film.

22. The semiconductor device of claim 21, wherein the gate insulating film contains silicon dioxide as a main component and nitrogen.

23. A semiconductor device comprising:

a semiconductor substrate;

a gate insulating film formed on the semiconductor substrate; and

a gate electrode formed on the gate insulating film,

wherein the gate insulating film contains silicon dioxide as a main component and nitrogen and has a physical thickness of not less than 0.3 nm and not more than 3 nm, and

wherein the silicon dioxide is formed using a solution containing an oxidizer.